

WHAT IS CLAIMED IS:

1. An apparatus for charging a rechargeable lead-acid battery, said apparatus comprising:

generator means for generating a charging current for charging the battery, and an overcharge current increment to be added to the charging current to yield an overcharge current; and,

controller means for controlling said generator means, said controller means including

(a) feedback means for determining at least one of a charge acceptance ability and a state of charge of the rechargeable lead-acid battery during recharging;

(b) overcharge instruction means for determining the overcharge current, the overcharge current exceeding the charge acceptance ability of the battery; and,

(c) current control means for controlling the generator to supply the charging current and the overcharge current increment, the current control means being operable to deliver the overcharge current to the battery during charging.

2. The apparatus as defined in claim 1 wherein

the overcharge instruction means is operable to determine an overcharge duration and an overcharge time; and,

the current control means is operable to deliver the overcharge current to the battery for the overcharge duration at the overcharge time.

3. The apparatus as defined in claim 2 wherein the overcharge time is determined to be after the state of charge of the lead-acid battery reaches 60%.

4. The apparatus as defined in claim 2 wherein the overcharge duration is

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between a half minute and five minutes, and the overcharge current exceeds the charge acceptance ability of the lead-acid battery by less than one fifth of the battery capacity and by more than one twentieth of the battery capacity.

5. The apparatus as defined in claim 2 wherein the overcharge instruction means determines a plurality of overcharge times, an associated overcharge current for each overcharge time, and an associated overcharge duration for each overcharge time;

the associated overcharge duration for each overcharge time being between a half minute and five minutes; and,

the associated overcharge current for each overcharge time exceeds the charge acceptance ability of the lead-acid battery at the overcharge time by less than one fifth of the battery capacity and by more than one twentieth of the battery capacity.

6. The apparatus as defined in claim 5 wherein the plurality of overcharge times are after the state of charge of the battery is at least 60% and before the state of charge of the battery is 100%.

7. The apparatus as defined in claim 6 wherein after the associated overcharge duration for each overcharge time has elapsed, the generator means is operable to supply an associated voltage-stabilizing current to the battery for an associated voltage-stabilizing interval before the charging current is restored, the associated voltage-stabilizing current for each overcharge time being less than a tenth of the battery capacity.

8. The apparatus as defined in claim 7 wherein the associated voltage-stabilizing interval for each overcharge time is at least five seconds.

9. The apparatus as defined in claim 7 wherein a total overcharge delivered during charging of the battery is less than 5% of a total charge provided to the battery

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during recharging.

10 The apparatus as defined in claim 6 further comprising temperature sensing means for determining an internal temperature of the battery, wherein the overcharge instruction means is operable to adjust the overcharge current depending on the internal temperature of the battery.

11. A method for recharging a rechargeable lead-acid battery, the method comprising:

- (a) generating a charging current for charging the battery;
- (b) supplying the charging current to the battery;
- (c) determining at least one of a charge acceptance ability and a state of charge of the rechargeable lead-acid battery;
- (d) determining the overcharge current, the overcharge current exceeding the charge acceptance ability of the battery;
- (e) determining an overcharge current increment to be added to the charging current to yield the overcharge current; and
- (f) during step (b), supplying the overcharge current increment to the battery, the current control means being operable to deliver the overcharge current to the battery during charging.

12. The method as defined in claim 11 wherein an overcharge duration and an overcharge time is determined, and the overcharge current is supplied to the battery for the overcharge duration at the overcharge time.

13. The method as defined in claim 12 wherein the overcharge time is after the state of charge of the lead-acid battery reaches 50%.

14. The method as defined in claim 12 wherein the overcharge duration is between a half minute and five minutes, and the overcharge current exceeds the charge acceptance ability of the lead-acid battery by less than one fifth of the battery capacity and by more than one twentieth of the battery capacity.

15. The method as defined in claim 12 wherein
a plurality of overcharge times, an associated overcharge current for each overcharge time, and an associated overcharge duration for each overcharge time, are determined;

the associated overcharge duration for each overcharge time is between a half minute and five minutes; and,

the associated overcharge current for each overcharge time exceeds the charge acceptance ability of the lead-acid battery at the overcharge time by less than one fifth of the battery capacity and by more than one twentieth of the battery capacity.

16. The method as defined in claim 15 wherein the plurality of overcharge times are after the state of charge of the battery is at least 60% and before the state of charge of the battery is 100%.

17. The method as defined in claim 16 wherein after the associated overcharge duration for each overcharge time has elapsed, an associated voltage-stabilizing current is delivered to the battery for an associated voltage-stabilizing interval before the charging current is restored, the associated voltage-stabilizing current for each overcharge time being less than a tenth of the battery capacity.

18. The method as defined in claim 17 wherein the associated voltage-stabilizing interval for each overcharge time is at least five seconds.

19. The method as defined in claim 17 wherein a total overcharge delivered during charging of the battery is less than 5% of a total charge provided to the battery

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during recharging.

20. The method as defined in claim 16 further comprising determining an internal temperature of the battery and adjusting the overcharge current depending on the internal temperature of the battery.

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